REMARKS

Claims 71-125 are pending in this application. By this Amendment, Figure 11 is revised to include the legend "Related Art" as requested by the Patent Office and the previously pending claims are canceled in favor of new claims 71-125.

No new matter is added by this Amendment. Support for new claims 71-125 may be found throughout the originally filed application. As examples, support for new independent claim 89 is found at page 11, lines 6-20, for example.

I. Supplemental Amendment Filed October 3, 2003 with Translation

The Office Action did not refer to the Supplemental Amendment filed on October 3, 2003. A verified translation of the priority Japanese patent application for the present application was filed with that Supplemental Amendment. In the event the Supplemental Amendment never became associated with the file, attached hereto is a courtesy copy of the verified translation of the priority document that was originally filed on October 3, 2003.

II. Objection to the Drawings

Figure 11 was again objected to as allegedly requiring a legend "such as --Prior Art--" on the grounds that the figure allegedly does not illustrate an aspect of the claimed invention.

While Applicants continue to disagree with the Patent Office's characterization of Figure 11 as being within the realm of prior art for all the reasons detailed in the September 17, 2003 Amendment, Applicants herein amend Figure 11 to include the legend "Related Art." Such legend is appropriate in notating that what is shown in Figure 11 is not an aspect of the claimed invention.

For the foregoing reasons, reconsideration and withdrawal of the objection to the drawings are respectfully requested.

III. Rejection under 35 U.S.C. §112, first paragraph

Prior claims 32, 34, 36, 38, 40, 42, 45, 50, 53-55, 58-65, 67 and 69-70 were rejected under 35 U.S.C. §112, first paragraph as allegedly not being enabled by the specification. This rejection is respectfully traversed.

The Office Action alleged that the previous claim language "the formation of said thin film is conducted at a thin film deposition rate in a manner that a particle occurrence frequency dependent on the thin film deposition rate is restrained so that the production yield rate dependent on the particle occurrence frequency is within tolerance" was not enabled by the specification.

While Applicants disagree with the assertion of the Patent Office, Applicants nevertheless note that the cited language is not used in the new claims 71-125. Accordingly, this rejection is believed to be moot.

For the foregoing reasons, reconsideration and withdrawal of this rejection are respectfully requested.

IV. Rejection under 35 U.S.C. §112, second paragraph

Prior claims 32, 34, 36, 38, 40, 42, 45, 50, 53-55, 58-65, 67 and 69-70 were rejected under 35 U.S.C. §112, second paragraph as allegedly being indefinite because the claim term "tolerance" was not defined in the specification. This rejection is respectfully traversed.

While Applicants disagree with the assertion of the Patent Office, Applicants nevertheless note that the cited language is not used in the new claims 71-125. Accordingly, this rejection is believed to be moot.

For the foregoing reasons, reconsideration and withdrawal of this rejection are respectfully requested.

V. Prior Art Rejections

The following prior art rejections were included in the Office Action:

(1) claims 31, 32, 43, 47, 49, 68 and 69 were rejected under 35 U.S.C. §102(a) as allegedly being unpatentable over Shinji (JP 11-012730) with Yang (U.S. Patent No. 6,358,636);

(2) claims 50-54, 60, 63, 67 and 70 were rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Shinji with Yang in view of Inoue (U.S. Patent No. 6,309,515);

(3) claims 33, 34, 41, 42 and 55-57 were rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Shinji with Yang in view of Inoue and further in view of Mitsui (U.S. Patent No. 6,087,047); and

(4) claims 31-34, 41, 42, 48-50, 53-57, 60, 64-66, 69 and 70 were rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Mitsui.

Each of the rejected claims has been canceled, and the rejections are therefore believed to be moot. However, for completeness, Applicants address the teachings of the references with respect to the newly added claims below.

1. Antedating the Cited Art

The present application claims foreign priority to Japanese Patent Application No. 10-217433 filed in Japan on July 31, 1998, and a verified translation of this priority document has been submitted to the Patent Office as discussed above.

The filing date of the Japanese priority application is prior to the publication date of Shinji (published January 19, 1999) and the earliest U.S. filing dates of Yang (November 5, 1998), Inoue (October 29, 1998) and Mitsui (September 15, 1998).

Thus, none of these cited references are prior art against any of the present claims supported by the priority application, which Applicants respectfully submit includes at least new claims 71-76.

Accordingly, Applicants submit that at least claims 71-76 may not be rejected relying upon any of Shinji, Yang, Inoue and Mitsui.

2. Claims 77-88

Applicants submit that neither Shinji nor Mitsui teach or suggest the method of manufacturing a photomask blank as recited in new claim 77 and claims 78-88 dependent therefrom.

Shinji relates to a technique to form a fine integrated circuit pattern on a semiconductor wafer. Shinji teaches that a chromium thin film of 50 nm thickness is formed on a bare silicon substrate of 480 μm thickness by sputtering using an RF magnetron sputtering system, and using a mixture gas of He (75 to 95% content) and Ar (5 to 25% content) as a sputter gas. In this case, helium, whose atomic number is smaller than argon, is used as a sputter gas. Therefore, in a curved line showing the relationship between a sputtering gas pressure and the film stress, the inclination of a slope formed when the compression stress changes into a tensile stress can be made smooth, thus enhancing the controllability of the stress.

New claim 77, however, recites that the "thin film is formed utilizing a gas in which the content of helium gas is 30 to 90 vol% as the atmosphere gas, at a speed selected for particles in the thin film to be within a suitable range for the thin film, as the speed for forming the thin film in the atmosphere gas." Shinji neither discloses nor suggests any matter relating to the above-described claim feature.

According to the examination and study undertaken by the inventors of the present application, for example, it was found that particles were increased by simply slowing down

the deposition rate of the thin film, thereby enlarging crystal grain of the thin film, and the film stress was also enlarged accordingly. See the background discussion in the present specification. Meanwhile, it was found that when the helium content in an atmosphere gas was adjusted (30 to 90 vol%), and when the thin film contains helium, particles can be suppressed so as to satisfy a good product range of the thin film, in a speed within a suitable range when relatively slowing down the deposition rate of the thin film, and also the crystal grain of the thin film can be made small and the film stress can be suppressed to be small enough to obtain a desired pattern position accuracy.

The present invention is based on the above-described fact firstly elucidated by the inventors of this application, and Shinji does not disclose any feature relating to such a fact. Without such an elucidation, the present invention is not achieved.

Mitsui describes a halftone phase shifting mask blank in which a semi-transparent film is formed on a transparent substrate, the semi-transparent film including at least one kind of the elements selected from silicon, nickel, nitrogen, oxygen, and hydrogen. If a mixture gas of He, Ar, and Xe, and a mixture gas of nitrogen and oxygen are used, nitrogen, oxygen, and hydrogen are easily captured in the film. The semi-transparent film is formed by sputtering using a mixture gas of Ar, N_2, O_2, H_2, at a flow rate of about 20 to 71 to 1 to 5 (Embodiment 3), Ar and N_2 at a flow rate of about 4 to 6 (Embodiment 6), and Ar, N_2, H_2, at a flow rate of about 3 to 6 to 1 (Embodiment 7).

As with Shinji discussed above, Mitsui does not disclose the above-discussed feature recited in claim 77 that is based on the fact firstly elucidated by the inventors of this application.

According to the Patent Office, Ar gas in the Embodiments 3, 6 and 7 of Mitsui can be replaced with helium gas. However, the helium gas is an extremely light gas, and therefore when the He gas is used instead of Ar gas in these embodiments, a sputter target can

not be sputtered, thereby allowing no film to be formed thereon. Moreover, although helium gas is suggested, inactive gas (rare gas) is simply cited as an example. Therefore, the subject matter of this invention is not disclosed, and the effect of including helium gas is not disclosed.

Accordingly, Mitsui also would not have led one of ordinary skill in the art to the claimed invention recited in claim 77 or claims dependent therefrom, as the present invention is not achieved from the teachings of Mitsui in the manner alleged by the Patent Office.

3. **Claims 89-97**

Applicants submit that none of Shinji, Inoue or Mitsui teach or suggest the method of manufacturing a photomask blank as recited in new claim 77 and claims 78-88 dependent therefrom.

Shinji merely describes that a chromium thin film of 50 nm thickness is formed on a bare silicon substrate of 480 μm thickness by sputtering using an RF magnetron sputtering system, and using a mixture gas of He (75 to 95% content) and Ar (5 to 25% content) as a sputter gas. In this case, helium, whose atomic number is smaller than argon, is used as a sputter gas. Therefore, in a curved line showing the relationship between a sputtering gas pressure and the film stress, the inclination of a slope formed when the compression stress changes into a tensile stress can be made smooth, thus enhancing the controllability of the stress.

Meanwhile, according to the present invention as recited in claim 89, the thin film is formed at a thin film deposition rate to allow good film quality without particles in the thin film, by suppressing frequency of particle occurrence which is dependent on the deposition rate of the thin film. Further, before introducing an atmosphere gas into a vacuum chamber, correlation between the content of helium gas included in the atmosphere gas and film stress of the thin film is previously determined, and the content of the helium gas is determined

from the correlation, for the thin film to have a film stress with which the mask pattern obtained after patterning of the thin film becomes a desired pattern position accuracy, and in the atmosphere gas including the helium gas, the thin film is deposited by sputtering.

These features of claim 89 are nowhere taught or suggested in Shinji.

Inoue relates to a manufacturing method of a semiconductor device, and to sputter equipment used for the semiconductor manufacturing device. The film formed on a silicon substrate is a high-melting-point metal film. In Fig. 20 and Fig. 21, sputter electric power, deposition rate and film yield (good product rate) are shown. However, causes for the defect in the film quality are different from those of the claimed invention. Further, there is a difference between the present embodiment and Inoue in that according to Inoue, as shown in Fig. 20 and Fig. 21, larger sputtering electric power and faster deposition rate are preferable, while according to the present invention, slower deposition rate is preferable so that film yield is not lowered due to deteriorating film quality by particles from a target, and by particle occurrence due to abnormal discharge by a reactive sputtering.

Shinji and Inoue are different in film forming materials, and each reference has no feature in common, and therefore there is no motivation for one to have combined the teachings of Shinji and Inoue in the manner alleged in the Office Action. Accordingly, the present invention would not have been derived by one of ordinary skill in the art from Shinji and Inoue.

In addition, Mitsui, and Shinji and Inoue are different in that Mitsui discloses a photomask technique as will be described later. These three references thus also do not have any subject matter in common, and therefore there is no motivation for one to have combined Mitsui, and Shinji and Inoue.

Regarding Mitsui, Mitsui merely describes a halftone phase shifting mask blank in which a semi-transparent film is formed on a transparent substrate, the semi-transparent film

including at least one kind of the elements selected from silicon, nickel, nitrogen, oxygen, and hydrogen. If a mixture gas of He, Ar, and Xe, and a mixture gas of nitrogen and oxygen are used, nitrogen, oxygen, and hydrogen are easily captured in the film. The semi-transparent film is formed by sputtering using a mixture gas of Ar, N_2, O_2, H_2, at a flow rate of about 20 to 71 to 1 to 5 (Embodiment 3), Ar and N_2 at a flow rate of about 4 to 6 (Embodiment 6), and Ar, N_2, H_2, at a flow rate of about 3 to 6 to 1 (Embodiment 7). Xe gas and He gas can be used instead of Ar.

Meanwhile, according to the embodiment of claim 89, the thin film is formed at a thin film deposition rate to allow good film quality without particles in the thin film, by suppressing frequency of particle occurrence which is dependent on the deposition rate of the thin film. Further, before introducing an atmosphere gas into a vacuum chamber, correlation between the content of helium gas included in the atmosphere gas and film stress of the thin film is previously determined, and the content of the helium gas is determined from the correlation for the thin film to have a film stress with which the mask pattern obtained after patterning of the thin film becomes a desired pattern position accuracy, and in the atmosphere gas including the helium gas, the thin film is deposited by sputtering.

These aforementioned features recited in claim 89 are not disclosed in Mitsui at all. Specifically, in Mitsui, although helium gas is suggested, inactive gas (rare gas) is simply cited as an example, and therefore the technical idea of this embodiment is not disclosed.

For the foregoing reasons, Applicants submit that none of the cited references would have taught or suggested the features of claims 89-97.

4. Claims 98-107

Applicants submit that neither Shinji nor Mitsui teach or suggest the method of manufacturing a photomask blank as recited in new claim 98 and claims 99-107 dependent therefrom.

Regarding Shinji, Shinji describes a chromium thin film of 50 nm thickness formed on a bare silicon substrate of 480 μm thickness by sputtering using an RF magnetron sputtering system, and using a mixture gas of He (75 to 95% content) and Ar (5 to 25% content) as a sputter gas. In this case, helium whose atomic number is smaller than that of argon is used as a sputter gas. Therefore, in a curved line showing the relationship between a sputtering gas pressure and the film stress, the inclination of a slope formed when the compression stress changes into a tensile stress can be made smooth, thus enhancing the controllability of the stress.

Meanwhile according to the embodiment defined by claim 98, the thin film (material including one or a plurality of transition metals or the compounds thereof, and including at least any one of the elements selected from carbon, oxygen, and nitrogen) contains helium, thereby suppressing the film stress to be small and the thin film has inner tensile stress, and also the content of He in the thin film is in a range of a film stress with which an amount of change in flatness becomes 2 μm or less.

Shinji does not disclose the above-described structure. More specifically, according to embodiments of the present invention, frequency of particle occurrence is dependent on the deposition rate of the thin film, and therefore when slowing down the deposition rate, the frequency of occurrence is also made smaller accordingly, thereby making a good film quality of the thin film. In view of this structure, the thin film is formed at a thin film deposition rate for good film quality to be made without particles occurred in the thin film.

Although the crystal grain of the thin film becomes larger and the film stress becomes larger accordingly when slowing down the deposition rate of the thin film, the technical idea is that by adjusting the content of helium in an atmosphere gas for the thin film to contain helium, even if slowing down the deposition rate of the thin film, an amount of change in flatness becomes 2 μm or less, whereby a photomask blank is obtained in which the thin film

having a film stress capable of obtaining a desired pattern position accuracy is formed. Shinji does not suggest the above-described technical features at all.

According to the Patent Office, the chromium thin film of Shinji is recognized as a film having an amount of change in flatness of 2 μm or less. However, the material of the thin film of Shinji is different from that of the present invention. That is, the thin film of Shinji is made of chromium, while the thin film of the present invention is made of at least one of the elements including carbon, oxygen and nitrogen. Generally, it is well recognized that according to the difference of materials of the thin film, the condition of the thin film (crystal grain) formed on the transparent substrate by a sputtering method is changed, and the film stress is also changed accordingly. Therefore, it is not appropriate or possible to conclude that the chromium thin film of Shinji is within a range of an amount of change in flatness as recited in claim 98.

Regarding Mitsui, Mitsui simply discloses a halftone phase shifting mask blank in which a semi-transparent film is formed on a transparent substrate, the semi-transparent film including at least one kind of the elements selected from silicon, nickel, nitrogen, oxygen, and hydrogen. The semi-transparent film is formed by sputtering using a mixture gas of Ar, N_2, O_2, H_2, at a flow rate of about 20 to 71 to 1 to 5 (Embodiment 3), Ar and N_2 at a flow rate of about 4 to 6 (Embodiment 6), and Ar, N_2, H_2, at a flow rate of about 3 to 6 to 1 (Embodiment 7). It is also indicated that Xe gas and He gas can be used instead of Ar.

Meanwhile, according to the embodiment of claim 98, when the thin film (material including one or a plurality of transition metals and the compounds thereof, and including at least any one of the elements selected from carbon, oxygen, and nitrogen) contains helium, the film stress is thereby suppressed to be small. Further, the thin film has an inner tensile stress, and the content of helium in the thin film is within a range of the film stress with which the amount of change in flatness becomes 2 μm or less.

Mitsui does not disclose or suggest the above-described features at all. According to Mitsui, the semi-transparent film has an amorphous structure containing coupling of Si-N, and coupling of Si-H. Therefore, it is considered that the formed film is a film prone to compression. Such a film is different from the film of the invention of claim 98.

For the foregoing reasons, Applicants submit that none of the cited references would have taught or suggested the features of claims 98-107.

5. Claims 108-117

Applicants submit that Shinji also would not have taught or suggested the method of manufacturing a photomask blank as recited in new claim 108 and claims 109-117 dependent therefrom.

Again, Shinji discloses a chromium thin film of 50 nm thickness is formed on a bare silicon substrate of 480 μm thickness by sputtering using an RF magnetron sputtering system, and using a mixture gas of He (75 to 95% content) and Ar (5 to 25% content) as a sputter gas. Helium, whose atomic number is smaller than that of argon, is used as a sputter gas. Therefore, in a curved line showing the relationship between a sputtering gas pressure and the film stress, the inclination of a slope formed when the compression stress changes into a tensile stress can be made smooth, thus enhancing the controllability of the stress.

In the invention of claim 108, however, when the thin film (material including one or a plurality of transition metals or the compounds thereof, and including at least any one of the elements selected from carbon, oxygen, and nitrogen) contains helium, the film stress is suppressed to be small. In addition, the size of the crystal grain of the thin film is 1 to 7 nm.

More specifically, according to the invention of claim 108, although by only slowing down the deposition rate of the thin film, the size of the crystal grain of the thin film becomes large, and the film stress also becomes large accordingly. However, by adjusting the content of helium in the atmosphere gas, and when the thin film contains helium, the size of the

crystal grain is made small to be 1 to 7 nm even when slowing down the deposition rate of the thin film. Thus, a photomask blank can be obtained in which the thin film having the film stress capable of obtaining a desired pattern position accuracy is formed. Shinji does not disclose these features at all.

According to the Patent Office, the crystal grain of the chromium thin film of Shinji is recognized as the film within a range defined by claims. However, the present invention is different from Shinji in the material of the thin film. Specifically, the material of the thin film of claim 108 is selected from the elements including at least one of the elements such as carbon, oxygen and nitrogen, while the material of the thin film of Shinji is a chromium thin film. It is understood that according to the difference of materials of the thin film, the condition of the thin film (crystal grain) formed on the transparent substrate by a sputtering method is changed. Therefore, the chromium thin film of Shinji is erroneously recognized by the Patent Office as the same crystal grain as that of the present invention.

Accordingly, Shinji would not have led one of ordinary skill in the art to the claimed invention recited in claim 108 or claims dependent therefrom.

6. Claims 118-125

Applicants submit that none of Shinji, Inoue or Mitsui teach or suggest the method of manufacturing a photomask blank as recited in new claim 118 and claims 119-125 dependent therefrom.

Specifically, none of Shinji, Inoue or Mitsui describe or suggest the laminated film structure, and also fail to teach or suggest that helium is contained in the thin film.

A photomask blank having a thin film formed on a transparent substrate, wherein the thin film has a light-shielding function and contains one or a plurality of transition metals or the compounds thereof, also the thin film is a laminated film of a light-shielding film that contains carbon and an anti-reflective film that contains oxygen, and a nitride film containing

nitrogen and the same transition metal material as metal material contained in the thin film is formed between the transparent substrate and the laminated film, and the thin film also contains He, is recited in claim 118. None of Shinji, Inoue or Mitsui teach or suggest a photomask blank having all of these recited features.

For the foregoing reasons, Applicants submit that the cited references also fail to teach or suggest the invention as recited in claims 118 to 125.

VI. Conclusion

In view of the foregoing, it is respectfully submitted that this application is in condition for allowance. Favorable reconsideration and prompt allowance of claims 71-125 are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact the undersigned at the telephone number set forth below.

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